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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/539,624	06/17/2005	Naoya Matsuoka	050340-0190	4578

20277 7590 04/21/2011

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EXAMINER	
HAN, KWANG S	
ART UNIT	PAPER NUMBER
1727	
MAIL DATE	DELIVERY MODE
04/21/2011	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/539,624	MATSUOKA, NAOYA	
	Examiner	Art Unit	
	Kwang Han	1727	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 February 2011*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *18-20 and 22-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *18-20 and 22-24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

FUEL CELL SYSTEM WITH CONTROL OF MOISTURE-ADJUSTED GAS

Examiner: K. Han SN: 10/539,624 Art Unit: 1727 April 21, 2011

Detailed Action

1. The Applicant's amendment filed on February 14, 2011 was received. Claim 21 was cancelled. Claim 18 was amended.

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim Objections

3. The objection to claim 18 has been withdrawn in view of the Applicants amendment to the claim.

Claim Rejections - 35 USC § 103

4. Claims 18-20, 22, and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mathias et al. (US 6376111) in view of Busenbender (US 2003/0039870) and Suzuki et al. (US 2001/0010872).

Regarding claims 18, 19, 22, and 23, Mathias discloses a fuel cell system comprised of the following:

- an anode (18) which contacts the fuel gas (2:30-31) ,
- a cathode (16) which contacts the oxidant gas (2:28-30),
- an electrolyte membrane (14) held between the anode and cathode (Figure 1),

- a moisture adjusted gas generating mechanism (2:54-3:7), and
- a programmable controller (44) (4:7-9).

Mathias further discloses test values at 50% relative humidity and 73% relative humidity for the cathode and anode while varying the humidity for the anode and cathode respectively, which shows efficiency of the fuel cell is a function of the humidity of the fuel cell (5:31-6:8) affecting high frequency resistance values, cell voltage, so the membrane is sufficiently humidified but not flooded with water or too dry (4:1-9) teaching relative humidity within the fuel cell is a result effective variable. It would have been obvious to one of ordinary skill in the art at the time of the invention to vary the relative humidity since it has been held that discovering the optimum ranges for a result effective variable such as relative humidity involves only routine skill in the art in the absence of showing of criticality in the claimed range (MPEP 2144.05) In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). One of ordinary skill in the art would readily recognize that the relative humidity of the fuel cell, even in a shutdown condition should maintain the same range of humidity since the condition of the membrane should be maintained for optimal condition when brought back into operation while factoring in environmental conditions during periods of both operation and shutdown. Mathias is silent towards the measurement of temperature to control the humidity within the fuel cell and to also determine the target humidity based on a temperature of the fuel cells after power generation is halted.

Busenbender teaches sensors which can detect both an ambient temperature (outside temperature) or a fuel cell temperature [0006] to send a temperature-based

control signal to a control system [0014] as part of a system for the benefit of avoiding of freezing water present in a fuel cell during periods of inactivity [Abstract] with respect to a predetermined threshold temperature [0017]. It would have been obvious to one of ordinary skill in the art at the time of invention to use a temperature sensor based control system with the controller of Mathias during periods of inactivity because Busenbender teaches and recognizes the need to avoid freezing of water in a fuel cell during periods of inactivity and low temperature.

Suzuki et al. teaches a control system [0033] which directs dry air to remove residual moisture directly to the fuel cell [0066], and thereby changing the humidity level, in a fuel cell system to prevent freezing [0043, 0048]. It would have been obvious to one of ordinary skill in the art at the time of the invention to provide controlled modification to target humidity levels using dry air within the controller of Mathias and Busenbender's fuel cell, because Suzuki teaches changing the humidity level to remove residual moisture in a fuel cell system allows for the prevention of freezing.

Regarding claim 20, Mathias discloses a sensor (42) which detects a wet condition of the fuel cell and the measurement of the resistance within the fuel cell assembly to determine the humidity level within the system (3:42-46) and the recognition of the humidification to be in a nominal range so the membrane is not too dry or to be flooded (4:1-9).

5. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mathias et al., Busenbender, and Suzuki et al. as applied to claim 1 above, and further in view of Ban et al. (US 6350536) and Gilbert (US 2003/0170506).

Regarding claim 24, the teachings of Mathias, Busenbender, and Suzuki as discussed above are herein incorporated. Mathias further discloses a fuel cell stack (2:63-64) and an inlet and an outlet to the membrane electrode assembly (Figure1) with a sensor but is silent towards having a first and second sensor at the inlet and outlet respectively.

Ban et al. teaches a humidity sensor (23) placed at the inlet of the fuel cell to detect the wet condition of the processed air at the vicinity of the inlet of the fuel cell to provide a detection signal for when the compressor can be stopped (4:9-14). It would have been obvious to one of ordinary skill in the art at the time of the invention to apply Ban inlet placement of the humidity sensors in the fuel cell of Mathias as modified by Busenbender and Suzuki for the benefit of knowing when target humidity has been reached at the inlet of the fuel cell.

Gilbert teaches a humidity sensor placed (48) at the outlet of the fuel cell to detect the wet condition of the exhaust gases at the vicinity of the outlet of the fuel cell [0017, 0018] to gauge the operating conditions of the fuel cell. It would have been obvious to one of ordinary skill in the art at the time of the invention to apply Gilbert's outlet sensor in the fuel cell of Mathias as modified by Busenbender and Suzuki for the benefit of gauging the operating conditions of the fuel cell. It would further have been obvious to one of ordinary skill in the art at the time of the invention to apply Gilbert's

outlet placement of the humidity sensors in combination with the inlet humidity sensor of Ban and further in combination with the controller for the fuel cell of Mathias as modified by Busenbender, and Suzuki for the benefit of knowing when to stop the supply of moisture-adjusted gas as determined by the inlet and out sensors to know when the target humidity has been reached and to know the operating conditions of the fuel cell.

Response to Arguments

6. Applicant's arguments filed February 14, 2011 have been fully considered but they are not persuasive.

Applicant's principal arguments are:

(a) the controller and humidity control of the Mathias reference is performed for power efficiency during operation of the fuel cell and would not be performed when the fuel cells are not operating, and

(b) the claimed range of 15% to 95% relative humidity is a critical range and provides unexpected results.

In response to Applicant's arguments, please consider the following comments:

(a) the Mathias reference in view of the teachings of Busenbender and Suzuki et al. provides sufficient motivation to modify the operation of the controller to control the humidity of the fuel cell based on measure temperature when the fuel cell has stopped operation. Busenbender clearly recognizes the need for continued monitoring of the conditions of the fuel cell including temperature by way of the controller to minimize

freezing within the system [0014] and Suzuki recognizes a method for preventing freezing within the fuel cell by providing dry air to remove residual moisture (humidity control) [0066] as discussed in the rejection above. Mathias in view of Busenbender and Suzuki teaches a controller with continued operation during shutdown of the fuel cell measuring temperature to minimize negative conditions within the fuel cell such as freezing by controlling the humidity of the fuel cell. In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986), and

(b) the Mathias reference discloses that it is well recognized within the fuel cell art that the membrane should be sufficiently humidified but not flooded because it blocks the flow of reactants and not too dry otherwise the membranes resistance is too high (4:1-9; 19-30). As discussed above, the Suzuki reference recognizes that residual moisture should be removed to prevent freezing within the fuel cell. One of ordinary skill in the art readily recognizes that relative humidity is temperature and pressure dependent which when applied to a fuel cell in a shutdown condition with temperatures which can freeze the moisture present in the system, a removal of residual moisture as taught by Suzuki sufficiently makes obvious a relative humidity value below 95% relative humidity since residual moisture would readily be present well below the dew point (100% relative humidity). Furthermore, as recognized by Mathias, a minimum value of moisture content and humidity must be maintained within the membrane to keep it in

operational condition. Mathias further tests the relative humidity range in which the anode operates from 100-12% relative humidity and the cathode from 100 to 10% relative humidity (5:31-58) which shows drops in cell voltage and high frequency resistance due to insufficient moisture within the membrane and fuel cell near the lower range of relative humidity. One of ordinary skill in the art would find a minimum relative humidity well above 15% within the fuel cell as being obvious to keep the fuel cell in operating condition. Applicant's arguments for criticality and unexpected results for the claimed range of the relative humidity is found to be insufficient based on the disclosure of the prior art and knowledge of one of ordinary skill in the art.

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Contact/Correspondence Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kwang Han whose telephone number is (571) 270-5264. The examiner can normally be reached on Monday through Friday 8:00am to 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Barbara Gilliam can be reached on (571) 272-1330. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/K. H./
Examiner, Art Unit 1727

/Barbara L. Gilliam/
Supervisory Patent Examiner, Art Unit 1727